

Study of Intraperitoneal Instillation of Bupivacaine with Tramadol Versus Intraperitoneal Bupivacaine with Magnesium Sulphate for Post Operative Analgesia after Laparoscopic Cholecystectomy

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Abstract:

Introduction: Laparoscopic surgery is a modern minimally invasive technique increasingly utilized for a wide range of procedures, including cholecystectomy, appendectomy, hernia repair, and several other abdominal surgeries. Postoperatively patients commonly report diffuse pain in the abdomen, back, and shoulders, which is often attributed to pneumoperitoneum and diaphragmatic irritation caused by carbon dioxide insufflation. The incidence of shoulder pain following surgery ranges widely, affecting approximately 35% to 63% of patients. Intraperitoneal instillation of bupivacaine is an established technique for perioperative pain management, especially in laparoscopic procedures. Recently Magnesium sulfate (MgSO₄) also has been extensively studied as an adjuvant to bupivacaine in various regional anesthesia techniques. Its potentiating effects on perioperative analgesia and muscle relaxation have drawn attention recently. Tramadol is a centrally acting synthetic analgesic that offers analgesia for moderate to moderately severe pain while having a lower risk of respiratory depression and addiction compared to conventional opioids. Hence, the present study was conducted to compare the effect of intraperitoneal instillation of 0.25% bupivacaine with tramadol and 0.25% bupivacaine with magnesium sulphate for post operative analgesia after laparoscopic surgeries.

Methodology: The present prospective, study was conducted amongst 70, electively posted for laparoscopic cholecystectomy from Feb.2023 to July 2024 at the Department of Anesthesiology at tertiary care institute. Total number of patients were randomly divided into two groups: Group BT- Patients receiving 30 ml of 0.25% bupivacaine with 100mg of Tramadol. Group BM- Patients receiving 30 ml of 0.25% bupivacaine with 50mg/kg Magnesium sulphate. Surgeons were then allowed to start with their procedure and told to instruct us after dissection and removal Gall bladder so that local drug can be instilled before removal of trocar.

Results: The mean age of patients was 38.21 ± 7.6 years in Group BT and 37.4 ± 6.9 years in Group BM. Group BM consistently demonstrated significantly lower VAS scores compared to Group BT, particularly during the early postoperative period (up to 16 hours). The analgesic effect of Magnesium sulphate appeared to be more sustained, with delayed onset of moderate pain and longer pain-free intervals postoperatively. This translated into a significantly prolonged mean time to first rescue analgesia in Group BM (7.4 ± 1.32 hours) compared to Group BT (4.9 ± 1.10 hours), with a p-value of 0.009, indicating strong statistical significance. Patients in Group BM required a mean of 1.4 ± 0.40 g of paracetamol, whereas those in Group BT required 2.3 ± 0.52 g (p-value = 0.01). These findings highlight the enhanced analgesic efficacy and opioid-sparing potential of Magnesium sulphate as an adjuvant to Bupivacaine for intraperitoneal instillation.

Conclusion: In conclusion, intraperitoneal instillation of Bupivacaine 0.25% combined with Magnesium sulphate is a safe, simple, and effective technique for postoperative analgesia in patients undergoing laparoscopic cholecystectomy. It offers superior pain control in the immediate postoperative period, reduces the need for rescue analgesics, and minimizes the incidence of opioid-related adverse effects. Given its efficacy, low cost, and safety profile, this combination represents a valuable addition to multimodal analgesia protocols in day-care laparoscopic surgery.

Keywords: Magnesium Sulphate, Bupivacaine, Laparoscopic Cholecystectomy, Tramadol, Gall bladder.

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Introduction

Laparoscopic surgery is a modern minimally invasive technique increasingly utilized for a wide range of procedures, including cholecystectomy, appendectomy, hernia repair, and several other abdominal surgeries. The technique confers multiple advantages, including decreased postoperative pain and bleeding, reduced duration of recovery and hospitalization, and a consequent decline in overall healthcare costs. [1] Postoperatively patients commonly report diffuse pain in the abdomen, back, and shoulders, which is often attributed to pneumoperitoneum and diaphragmatic irritation caused by carbon dioxide insufflation. [2] Pain may present acutely and is typically self-limiting; however, it arises from tissue injury that induces measurable alterations in both the affected tissue and the nervous system.[3]

Effective postoperative pain management is a critical determinant for the safe discharge of patients from outpatient facilities, as poorly controlled pain is a leading contributor to extended recovery times and unexpected hospital admissions following ambulatory procedures.[4] The incidence of shoulder pain following surgery ranges widely, affecting approximately 35% to 63% of patients.[5]

In general, pain at rest typically diminishes within the first week following laparoscopic surgery. However, pain associated with movement—such as walking, coughing, or changing positions—is often more pronounced during the first 72 hours postoperatively. Inadequate management of postoperative pain can lead to both immediate and long-term adverse outcomes, potentially impacting morbidity and mortality rates.[5]

Acute postoperative pain has the potential to transition into chronic postsurgical pain (CPSP), which affects approximately 10–50% of patients following common surgical procedures. Chronic postsurgical pain (CPSP) is defined as pain that persists for more than 2 to 6 months following a surgical procedure.[6] Chronic postsurgical pain may result from ongoing inflammation or may involve a neuropathic component due to peripheral nerve injury sustained during surgery. Emerging evidence indicates that the intensity of acute postoperative pain is a key predictor for the development of chronic pain, underscoring the importance of effective early pain management to minimize long-term complications. Pain after laparoscopic surgery results from the stretching of the intra-abdominal cavity also due to [5] peritoneal inflammation and phrenic nerve irritation caused by residual carbon dioxide (CO₂) in the peritoneal cavity. Pain can prolong hospital stay and lead to increased morbidities. Intraperitoneal injections of local anaesthetic have been proposed to minimize post-operative pain after laparoscopic surgeries.[7]

Bupivacaine is widely utilized in various anesthetic techniques, including regional blocks, epidural anesthesia, spinal anesthesia, and local infiltration. Intraperitoneal instillation of bupivacaine is an established technique for perioperative pain management, especially in laparoscopic procedures. It entails the delivery of local anesthetics into the peritoneal cavity to achieve localized anesthesia of the surgical field and surrounding structures. This method has demonstrated significant efficacy in minimizing the requirement for systemic analgesics, thereby enhancing postoperative comfort. Additionally, it is regarded as a safe and reliable approach that supports faster recovery, reduces hospital stay duration, and may contribute to opioid-sparing or even opioid-free strategies.

Various adjuncts are added to local anaesthetic drugs for faster onset and to prolong duration of analgesia especially for postoperative period. Neostigmine, clonidine, soda-bicarb, fentanyl, opioid, and epinephrine have been used experimentally as well as conventionally as local anaesthetic adjunct. [8] Recently Magnesium sulfate (MgSO₄) also has been extensively studied as an adjuvant to bupivacaine in various regional anesthesia techniques. Its potentiating effects on perioperative analgesia and muscle relaxation have drawn attention recently. These characteristics of magnesium (anesthetic- and analgesic- sparing effect) enable anesthesiologists to reduce the use of anesthetics during surgery and the use of analgesics after surgery. Magnesium sulfate, as an analgesic adjunct, can also be useful in patients receiving total intravenous analgesia (TIVA).[9]

Tramadol is a centrally acting synthetic analgesic that offers effective pain relief through a dual mechanism.[10] Due to this multimodal mechanism, tramadol provides analgesia for moderate to moderately severe pain while having a lower risk of respiratory depression and addiction compared to conventional opioids.[11] Its unique pharmacological profile has led to its widespread use in perioperative pain management and as an adjunct in regional anaesthesia practices.

Hence, the present study was conducted to compare the effect of intraperitoneal instillation of 0.25% bupivacaine with tramadol and 0.25% bupivacaine with magnesium sulphate for post operative analgesia after laparoscopic surgeries.

Material and Methodology

This prospective, randomized, double-blinded study was conducted amongst 70 consenting patients who met a predefined inclusion criterion of either gender, electively posted for laparoscopic cholecystectomy

from Feb.2023 to July 2024 at the Department of Anesthesiology at tertiary care institute.

Inclusion Criteria: All patients of any gender of age group 16-65 years undergoing laparoscopic cholecystectomy under general anaesthesia, patients with ASA grade I and II and giving informed consent.

Exclusion Criteria: Patients having allergy to the study drugs (Bupivacaine, Tramadol, Magnesium Sulphate), active treatment for major illness or comorbidities, pregnant and lactating females, patients who are not willing to give consent, known hypomagnesaemia or hypermagnesaemia.

Methodology

All patients posted for laparoscopic cholecystectomy surgery in surgery operation theatre, those fulfilling the inclusion/ exclusion criteria and those who are willing to give written informed consent were included in the study. Out of the total sample size, total number of patients were randomly divided into two groups: Group BT- Patients receiving 30 ml of 0.25% bupivacaine with 100mg of Tramadol. Group BM- Patients receiving 30 ml of 0.25% bupivacaine with 50mg/kg Magnesium sulphate. After taking written informed consent and confirming NBM status Patients were

taken into operation theatres and attached with all the Standard monitors which included pulse oximetry, non-invasive blood pressure, end-tidal CO₂ and three-lead electrocardiogram. Patient was premedicated with Inj. Midazolam 0.02 mg/kg, Inj. Glycopyrrolate 0.004 mg/kg, Inj. Fentanyl 2 µg/kg. Then patient was induced with Inj Propofol 2mg/kg and Inj vecuronium 0.5 mg/kg. Patients were given appropriate inducing agent after proper mask holding, patient was intubated after proper relaxation of muscles and cords. Patient was maintained on Isoflurane and IV inj. Vecuronium as muscle relaxant. Surgeons were then allowed to start with their procedure and told to instruct us after dissection and removal Gall bladder so that local drug can be instilled before removal of trocar. Group BT patients were instilled with 30ml of 0.25% bupivacaine with 100 mg tramadol. Group BM patients were instilled with 30ml of 0.25% bupivacaine with 50 mg/kg of MgSO₄ (dose of bupivacaine not exceeding 2.0 mg/kg BW). Both the groups were given drugs through trocar before its removal on gall bladder bed. Degree of postoperative pain was assessed using Visual Analogue Scale (VAS) at the end of 1, 2, 4, 6, 8, 12, 16 and 24 h after surgery on scale of 10cms showing varying intensity of pain from 0cm to 10cm with 0cm showing no pain and 10 cms showing worst pain.

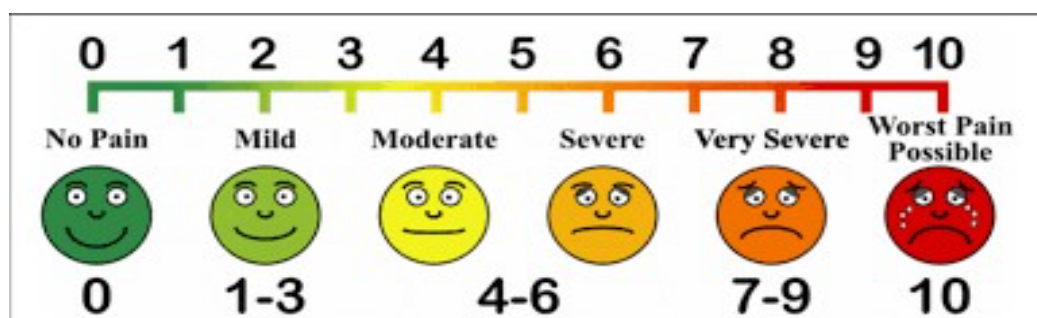


Figure 1: VAS scale for assessment of post operative pain.

The time duration of the first demand for analgesia and total paracetamol consumption in 24 h was recorded. IV paracetamol 1 g was given as rescue analgesic on demand or/and with VAS >3 up to a maximum dose of 4 g in 24 h. Vital parameters and any complications were also assessed post-operatively. Hemodynamic parameters and the following side effects of the

studied drugs were also observed during post-operative period at intervals of 5min, 10min, 15min, 20min, 30 min, 40 min, 50min, 1 h, 2 h, 4 h and 6 h 8h 12h 16h 20h 24h after shifting to recovery room: nausea and vomiting (NV), loss of tendon reflexes and hypotension (defined as more than 20% reduction of SBP and/or DBP from baseline).

Result

Table 1: Age distribution

Age in years	Group BT	Group BM	Total
20-30	6	5	11
31-40	12	13	25
41-50	10	9	19
51-60	7	8	15
Total	35	35	70
Mean $\pm$ SD	38.21 $\pm$ 7.6	37.4 $\pm$ 6.9	P value=0.82

Table 1 presents the age distribution of two groups, Group BT and Group BM, within the study population. The table shows that both groups consisted of 35 individuals, with a majority falling

within the 31-40 age group. The mean age for the Group BT was (38.21 ± 7.6) and that of the Group BM (37.4 ± 6.9) .

Table 2: Gender distribution.

Gender	Group BT	Group BM	Total
Male	15	15	30
Female	20	20	40
Total	35	35	70

Table 2 shows gender distribution of both study groups, with 35 in each. The percentage of females was found to be higher than males in each group.

Applying chi square test p value is 0.99, as p value is >0.05 , shows no statistical significance.

Table 3: Surgery Duration in Minutes.

Parameter	Group BT		Group BM		P value
	Mean	SD	Mean	SD	
Duration	63.2	9.8	61.9	10.1	0.8

Table 3 presents the mean duration of surgery was comparable between the two groups. In the Bupivacaine-Tramadol (BT) group, the average duration was 63.2 ± 9.8 minutes, while in the Bupivacaine-Magnesium (BM) group, it was $61.9 \pm$

10.1 minutes. The difference was not statistically significant ($p = 0.8$), indicating that the type of adjuvant used did not influence the duration of the surgical procedure.

Table 4: Mean Time to First Rescue Analgesia Demand (hours)

Treatment Group	Mean Time to First Rescue Analgesia (hrs)	SD	P value
Group BT	4.9	1.10	0.009
Group BM	7.4	1.32	

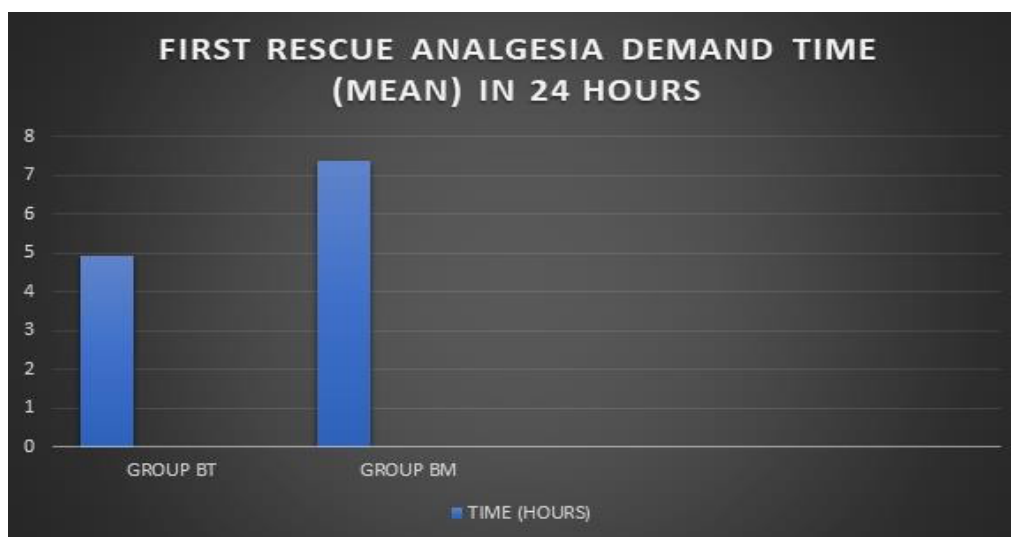


Chart 1: Mean Time to First Rescue Analgesia Demand (hours)

Table 4 presents the mean time to first rescue analgesia was compared between Group BT (Bupivacaine-Tramadol) and Group BM (Bupivacaine-Magnesium). In Group BT, the mean time to first analgesic requirement was 4.9 ± 1.10 hours, while in Group BM it was significantly longer

at 7.4 ± 1.32 hours. The difference between the two groups was statistically significant, with a p-value of 0.009, indicating that the addition of magnesium to bupivacaine prolonged the duration of postoperative analgesia more effectively than tramadol

Table 5: Mean of total rescue analgesia consumption in 24 hours

Treatment Group	Mean Total Analgesia Consumption (grams)	SD	P-value
Group BT	2.3	0.52	0.01*
Group BM	1.4	0.41	

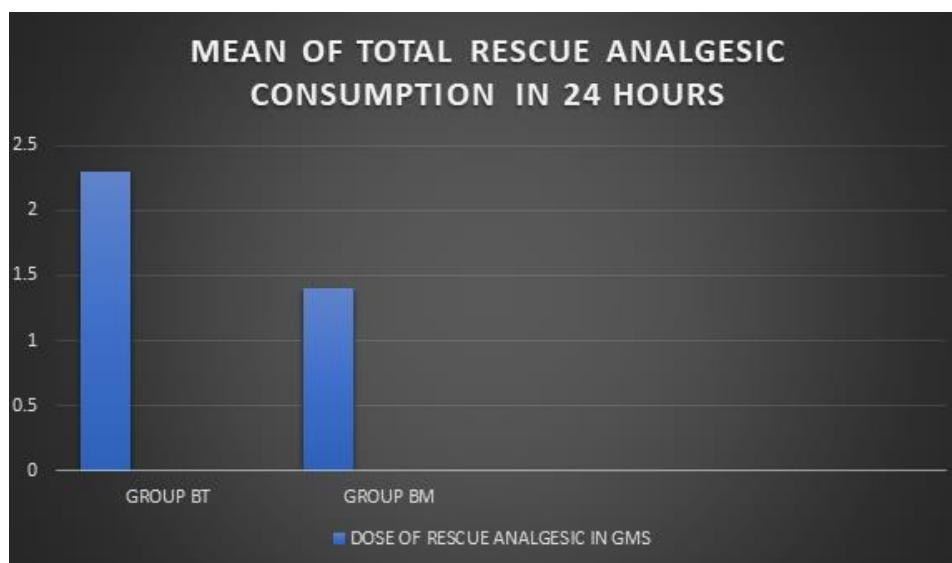
**Chart 2: Mean of total rescue analgesia consumption in 24 hours**

Table 5 presents the mean total analgesic consumption was significantly lower in the Bupivacaine-Magnesium (BM) group compared to the Bupivacaine-Tramadol (BT) group. The BT group required an average of 2.3 ± 0.52 grams,

whereas the BM group required only 1.4 ± 0.41 grams of analgesia. This difference was found to be statistically significant ($p = 0.01$), indicating improved analgesic efficiency in the BM group.

Table 6: VAS scoring

VAS	Group BT		Group BM		P value
	Mean	SD	Mean	SD	
Baseline	1.2	0.4	1.0	0.3	0.009*
30 min	1.5	0.5	1.3	0.5	0.002*
1 hour	1.9	0.5	1.7	0.6	<0.0001*
2 hour	2.5	0.6	2.1	0.5	<0.0001*
4 hour	3.2	0.8	2.4	0.6	<0.0001*
8 hour	3.4	0.6	2.5	0.5	<0.0001*
12 hour	2.6	0.5	1.8	0.4	<0.0001*
16 hour	2.2	0.4	1.5	0.3	<0.0001*
24 hour	1.8	0.4	1.2	0.3	<0.0001*

Table 6 presents the Postoperative pain intensity was measured using the Visual Analog Scale (VAS) at predefined time intervals: baseline, 30 minutes, 1, 2, 4, 8, 12, 16, and 24 hours following laparoscopic cholecystectomy in both Group BT (Bupivacaine-Tramadol) and Group BM (Bupivacaine-Magnesium). Both BT and BM groups experienced lower VAS scores, with

Group BM consistently demonstrating lower pain scores at each time point. Statistically significant differences ($p < 0.05$) in VAS scores were observed at all intervals, indicating superior analgesic efficacy of Bupivacaine-Magnesium over Bupivacaine-Tramadol. At baseline, the VAS score was slightly

lower in the BM group (1.0 ± 0.3) compared to BT (1.2 ± 0.4), which was statistically significant ($p = 0.009$). A similar trend was noted at 30 minutes and 1 hour, with Group BM showing significantly lower scores ($p = 0.002$ and $p < 0.0001$, respectively), suggesting early onset of effective analgesia. From 2 to 8 hours, the difference became more pronounced: at 2 hours, VAS was 2.5 ± 0.6 in BT vs. 2.1 ± 0.5 in BM ($p < 0.0001$). At 4 hours, BT had a higher VAS score (3.2 ± 0.8) compared to BM (2.4 ± 0.6), ($p < 0.0001$). At 8 hours, pain continued to be significantly lower in the BM group (2.5 ± 0.5) than the BT group (3.4 ± 0.6) ($p < 0.0001$). At 12, 16, and 24 hours, the VAS scores continued to favor the BM group with statistically significant

differences ($p < 0.0001$), indicating prolonged analgesic effect of the Bupivacaine-Magnesium combination. At 24 hours, BM group had a mean VAS score of 1.2 ± 0.3 vs. 1.8 ± 0.4 in BT group. These findings suggest that Group BM offered better

postoperative pain control, both in terms of earlier onset and longer duration of analgesia, as evidenced by consistently lower VAS scores across all time points.

Table 7: Post operative complications.

Complications	Group BT	Group BM
Nausea	3	0
Vomiting	2	0
Sedation	3	1
Shoulder pain	3	1
Bradycardia	0	1
Hypotension	0	1
Total with >1 complication	10	3

Table 7 presents that complications were more frequently reported in the Bupivacaine-Tramadol (BT) group compared to the Bupivacaine-Magnesium (BM) group. In Group BT, 3 patients experienced nausea, 2 had vomiting, 3 developed sedation, and 3 reported shoulder pain. In contrast, Group BM had no cases of nausea or vomiting, with only 1 patient each developing sedation and shoulder pain. Bradycardia and hypotension were not observed in the BT group but occurred in 1 patient each in the BM group. The total number of patients experiencing more than one complication was notably higher in the BT group ($n=10$) compared to the BM group ($n=3$), indicating a more favorable safety profile with the use of intraperitoneal Bupivacaine-Magnesium.

Discussion:

Postoperative pain following laparoscopic procedures arises from multiple sources, necessitating a multimodal approach to achieve effective pain control. The peritoneum is a delicate serous membrane that lines the abdominal cavity and envelops most intra-abdominal organs. Due to its fragile nature, it is highly vulnerable to injury and poorly equipped to tolerate environmental stressors such as cold, dry carbon dioxide used during laparoscopy. Utilizing opioid-sparing strategies can enhance postoperative pain management and contribute to the high success rate of outpatient laparoscopic cholecystectomy. However, accurately evaluating pain remains challenging due to individual variability in pain perception, its subjective nature, and the inherent difficulty in quantifying it.

In this study, we evaluated postoperative pain relief in patients undergoing laparoscopic cholecystectomy by comparing the efficacy of intraperitoneal instillation of 0.25% Bupivacaine combined with either Tramadol or magnesium sulphate. A total of 70 patients were included in the study. The local anesthetic mixtures were administered intraperitoneally at the end of the

surgery. Postoperative analgesia was subsequently assessed.

Comparison of age distribution: Cholelithiasis is characteristically a disease of middle-aged women. In the present study majority of the patients were in the age group of 30-40 years. The mean age in our study was 38.21 ± 7.6 and 37.4 ± 6.9 in BT and BM group respectively. Study by Usha et al [12] had mean age of 38.80 ± 8.96 in group of bupivacaine, 38.52 ± 9.01 in bupivacaine with tramadol group and 39.10 ± 8.46 in group of bupivacaine with dexmedetomidine which is comparable to our study. Rajkumar Reddy Inugala et al [13] had patients with mean age group of 39.23 ± 6.51 in test and 38.35 ± 7.48 in control group respectively that is comparable to our study. Study by Yadava et al [14] had the mean age of patients with 48.76 ± 8.76 years in the BT group and 48.81 ± 8.84 years in the BM group, which is comparable to the age distribution to our study.

Comparison of gender distribution: In our study, there was no statistical difference between the gender of the study groups, however overall, this study showed a female preponderance with a total of 40 females. Study by Yadava et al. [14] found among the study population the percentage of females was found to be higher than males in each group showing no statistically significant difference ($P > 0.05$). Shukla U, et al [12] also in their study showed a female preponderance. Mishra et al [15] found the percentage of female population (72%) was more in their study group.

Duration of surgery: In our study the mean duration of surgery was 63.2 ± 9.8 and 61.9 ± 10.1 minutes in Group BT and BM respectively as comparative to the study by B.Lakshmi Praveena et al [16] showed duration of surgery between range of 60-80 minutes. In the study conducted by Ambuj et al. [17] the mean duration of surgery was 53.61 ± 5.48 minutes in the BT group and 51.98 ± 7.13 minutes in the BM group, which aligns closely with the operative times observed in our study. Rohit

Kumar Mishra et al [15]. reported a mean duration of surgery of 68.63 ± 20.40 minutes in the BT group and 63.66 ± 16.83 minutes in the BM group, which is comparable to the operative duration observed in the present study.

Comparison of hemodynamic variables: No statistically significant differences were noted in the vital parameters like post-operative Respiratory rate, Spo2, or in the blood pressure between the two study groups but we also found that the addition of MgSO₄ to bupivacaine decreased the heart rate slightly less than baseline and became stable thereafter when compared to patients who were given bupivacaine and tramadol after laparoscopic cholecystectomy. Similarly study by Yadava et al [14] and Ambuj et al [17] showed there was slight decrease in heart rate with bupivacaine- mgso₄ which became stable thereafter and was showing no statistical significance. Samba Siva Rao Jupalli et al. [18] also in their study found that there was no statistical significance in hemodynamic variables which was comparable to our study.

Comparison of pain scales [vas scores]: In the present study, a statistically significant difference ($p < 0.05$) was observed in the VAS scores between the two treatment groups at all four-time intervals over the 12- hour postoperative period. Numerous studies have explored the use of various local anesthetic agents for postoperative analgesia, either alone, combined with normal saline, or with different adjuvants. Some researchers have also investigated the effect of altering the timing of intraperitoneal local anesthetic administration, such as instillation prior to gallbladder bed dissection or following the completion of the procedure. In our study, the local anesthetic combined with an adjuvant was instilled intraperitoneally at the end of the surgery, with the patient in the Trendelenburg position and prior to trocar removal. Our study noted a relatively lesser VAS scores in Group BM than in Group BT. All VAS scores had P values < 0.05 that showed statistical significance.

Samba Siva Rao Jupalli and K. Ravi Nayak [19] compared intraperitoneal Bupivacaine-Tramadol with Bupivacaine-Magnesium sulphate and found that both combinations provided effective postoperative analgesia, with the Bupivacaine-Magnesium group demonstrating overall lower VAS scores. Yadava et al. [17] found better pain control with Bupivacaine-Magnesium sulphate compared to Bupivacaine-Tramadol in their study. In line with these findings, our study also showed that Group BM experienced superior pain relief compared to Group BT. Elmansori et al. [20] reported significantly lower VAS scores in the Bupivacaine-Magnesium group compared to Bupivacaine alone, with no evident pain peak throughout the 24-hour period. This trend closely aligns with our study, where the Bupivacaine-Magnesium group

consistently showed lower VAS scores than the Bupivacaine-Tramadol group, further supporting the superior analgesic profile of Magnesium sulphate as an adjuvant.

Likely, in Smriti Anand et al. [21] study, the lowest VAS scores were observed in the Bupivacaine-only group, while the combination of reduced-dose Bupivacaine and Magnesium sulphate showed moderately higher VAS scores. Compared to her findings, our study noted lower VAS scores in the Bupivacaine-Magnesium group, likely due to the use of full-dose Bupivacaine (0.25%) along with Magnesium, suggesting that maintaining the standard concentration of the local anesthetic enhances analgesic efficacy when combined with an adjuvant.

Comparison of requirement of rescue analgesics:

Rescue analgesia time: In our study, the mean time to first rescue analgesia was significantly prolonged in the Bupivacaine–Magnesium group (7.4 ± 1.32 hours) compared to the Bupivacaine– Tramadol group (4.9 ± 1.10 hours), with a p-value of 0.009 indicating statistical significance. Mishra et al. [15] also reported a longer duration of analgesia in the Bupivacaine– Magnesium group (6.27 ± 1.07 hours) versus the Bupivacaine–Tramadol group (3.89 ± 1.08 hours), supporting the efficacy of magnesium in prolonging postoperative pain relief. Similarly, Yadava et al. [14] and Jupalli et al. [18] observed delayed need for rescue analgesia and reduced analgesic consumption in the Bupivacaine–Magnesium group compared to Bupivacaine–Tramadol, reinforcing the advantage of magnesium sulphate as an effective adjuvant in laparoscopic cholecystectomy.

Requirement of total analgesics in 24 hours: In the present study, the mean total paracetamol consumption in 24 hours was significantly lower in the Bupivacaine–Magnesium group (1.4 ± 0.40 g) compared to the Bupivacaine–Tramadol group (2.3 ± 0.52 g) ($p = 0.01$). This trend was similarly observed in Yadava et al.,[14] where the Bupivacaine–Magnesium group required 1.43 g and the Tramadol group required 2.39 g. Mishra et al. [15] reported higher absolute values, with mean consumption of 3.02 ± 0.52 g in the Bupivacaine–Tramadol group and 2.37 ± 0.49 g in the Bupivacaine–Magnesium group, yet still demonstrating a clear reduction in analgesic requirement with magnesium. Similarly, Sambasiva et al. [18] showed a statistically significant reduction, with 2.27 ± 1.14 g required in the Tramadol group versus 1.27 ± 0.61 g in the Magnesium group. These consistent findings across multiple studies further support the superior analgesic efficacy of intraperitoneal bupivacaine combined with magnesium sulphate in reducing

postoperative analgesic requirements following laparoscopic cholecystectomy.

Comparison of adverse effects: Local anaesthetic techniques are a key component of the multimodal strategy for postoperative pain control. One of their primary advantages is the avoidance of opioid-related adverse effects, which can impede early recovery and prolong hospital stay. Common side effects associated with opioids—such as postoperative nausea and vomiting, sedation, pruritus, and delayed return of gastrointestinal motility—can significantly affect patient comfort and outcomes. By reducing or eliminating the need for systemic opioids, local anaesthetics may facilitate faster recovery and earlier resumption of bowel function in the postoperative period.

In this study, postoperative nausea and vomiting (PONV) was observed in five patients in the Tramadol-Bupivacaine (BT) group, while none were reported in the Magnesium- Bupivacaine (BM) group, although this difference was not statistically significant. These findings are consistent with a previous study conducted by Yadava et al. [14] where preoperative infusion of magnesium sulphate (50 mg/kg)

during laparoscopic cholecystectomy was associated with a lower incidence of nausea compared to the Tramadol group. Magnesium sulphate acts by blocking NMDA receptors, which are involved in emetic pathways and structures related to the final common pathway for vomiting. NMDA antagonists, therefore, are considered to have potential as broad- spectrum antiemetics. However, current literature lacks sufficient data on the direct antiemetic effects of magnesium sulphate in the postoperative setting.

Similarly, in the study conducted by Mishra et al., [15] postoperative nausea and vomiting (PONV) was observed in patients belonging to the TB group, while no such events were reported in the MB group; however, the difference between the groups was statistically insignificant. In the study conducted by Sambasiva Rao Jupalli et al., [18] there was no incidence of postoperative nausea and vomiting (PONV) in Group BM, while 13.3% of patients in Group BT experienced PONV; however, the difference was not statistically significant. No other complications were reported in either group, which is in concordance with the findings of the present study.

Conclusion

Intraperitoneal instillation of magnesium sulphate 50 mg/kg in combination with 0.25% bupivacaine in elective laparoscopic cholecystectomy significantly reduces postoperative pain and decreases the total requirement for rescue analgesia within the first 24 hours, when compared to the combination of

tramadol with bupivacaine. This suggests that magnesium sulphate is a more effective adjuvant to intraperitoneal bupivacaine for postoperative analgesia in laparoscopic surgeries.

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